NDP gene

NDP, norrin cystine knot growth factor

Normal Function

The *NDP* gene provides instructions for making a protein called norrin. Norrin participates in chemical signaling pathways that affect the way cells and tissues develop. Studies suggest that norrin may play a role in Wnt signaling, which is important for cell division (proliferation), attachment of cells to one another (adhesion), cell movement (migration), and many other cellular activities.

Norrin is one of many proteins, or ligands, that can attach (bind) to other proteins called frizzled receptors. These receptors are embedded in the outer membranes of cells. Norrin binds with the receptor frizzled-4 (produced from the *FZD4* gene), fitting together like a key in a lock. When a ligand binds to a frizzled receptor, it initiates a multi-step process that regulates the activity of certain genes.

The norrin protein and its receptor frizzled-4 participate in developmental processes that are believed to be crucial for normal development of the eye and other body systems. In particular, norrin seems to play critical roles in the specialization of cells in the retina (the thin layer at the back of the eye that senses light and color) and the establishment of a blood supply to the retina and the inner ear.

Health Conditions Related to Genetic Changes

familial exudative vitreoretinopathy

Several *NDP* gene mutations have been found to cause the eye disorder familial exudative vitreoretinopathy. These mutations change single protein building blocks (amino acids) in the norrin protein, altering the normal folding of norrin or preventing it from binding to frizzled-4. The defective norrin disrupts chemical signaling in the developing eye, which interferes with the formation of blood vessels at the edges of the retina. The resulting abnormal blood supply to this tissue leads to retinal damage and vision loss in some people with familial exudative vitreoretinopathy.

Norrie disease

More than 75 mutations in the *NDP* gene have been identified in people with Norrie disease. These mutations affect the ability of the norrin protein to bind with frizzled-4, interfering with the specialization of retinal cells for their unique sensory function. As a result, masses of immature retinal cells accumulate in the back of the eyes. Disruption of norrin's role in the establishment of blood vessels supplying the eye eventually causes some of the tissues to break down.

Norrin is also expressed in other systems of the body, and the effects of the disorder can be widespread, including intellectual disability, seizures, behavioral problems, and delayed development. Specific abnormalities and their severity depend on the type and location of the *NDP* gene mutation. Mutations that delete portions of the *NDP* gene prevent production of norrin and result in severe problems affecting many body systems in addition to the eyes. Mutations that delete or change single amino acids usually result in less widespread effects.

other retinal dystrophies

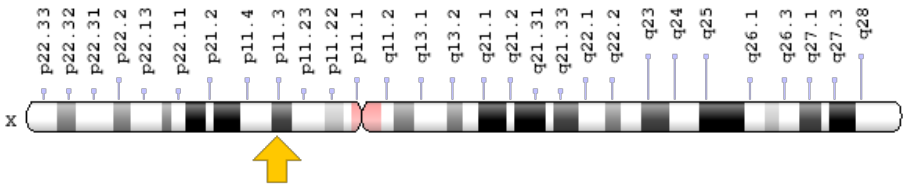
NDP gene mutations may cause other disorders that affect the retina. One mutation is associated with a disorder called Coats disease. This disorder causes leakage of blood vessels in the retina and retinal detachment, a condition in which layers of the retina separate, resulting in vision loss. Persistent hyperplastic primary vitreous (PHPV) is another retinal disorder that may be caused by *NDP* gene mutations. In persistent hyperplastic primary vitreous, a remnant of a blood vessel found in the eye before birth remains as a fibrous white stalk between the back of the eye and the lens. Persistent hyperplastic primary vitreous can cause vision loss through retinal detachment, cloudiness of the lens (cataract) or increased pressure inside the eye (glaucoma) that can damage the optic nerve.

In addition, *NDP* gene mutations may influence the course of a retinal disorder that affects some premature infants. Retinopathy of prematurity is a condition in which abnormal blood vessels appear in the retina and can cause retinal detachment. Babies with retinopathy of prematurity may experience improvement of the condition over time, but some *NDP* gene mutations have been associated with a worsening of the condition.

Chromosomal Location

Cytogenetic Location: Xp11.3, which is the short (p) arm of the X chromosome at position 11.3

Molecular Location: base pairs 43,948,776 to 43,973,675 on the X chromosome (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- ND
- NDP_HUMAN
- Norrie disease (pseudoglioma)
- norrin

Additional Information & Resources

Educational Resources

- Developmental Biology (sixth edition, 2000): The Wnt Pathway
  https://www.ncbi.nlm.nih.gov/books/NBK10043/#A1061

GeneReviews

- NDP-Related Retinopathies
  https://www.ncbi.nlm.nih.gov/books/NBK1331

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28NDP%5BTIAB%5D%29+OR+%28Norrie+disease%5BTIAB%5D%29%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+1800+days%22%5Bdp%5D

OMIM

- COATS DISEASE
  http://omim.org/entry/300216
- NDP GENE
  http://omim.org/entry/300658

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/GC_NDP.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=NDP%5Bgene%5D
- HGNC Gene Family: Endogenous ligands
  http://www.genenames.org/cgi-bin/genefamilies/set/542
- HGNC Gene Symbol Report
  http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=7678

- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/4693
- UniProt
  http://www.uniprot.org/uniprot/Q00604

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